ANTICORROSION TREATMENT OF SINTERED
CONSTRUCTIONAL PARTS OF BUSINESS MACHINES

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The present stage of development of powder metallurgy in the Soviet Union is characterized by extensive adoption of sintered constructional components in machine and instrument construction. A typical example of this trend has been the erection in recent years, at the Ryazan Business Machine Factory, of a well-equipped power metallurgy shop for the large-scale production of parts of adding machines, invoicing machines, and cash registers.

Employing powder metallurgy techniques for the production of these components has speeded up the entire process of manufacture of business machines and cut their cost by making it possible to dispense completely with all the costly specialized forms of casting and also with the difficult and slow machining of such components. Previously, the growing complexity of shape of these parts [2] meant using more and more extensively expensive automatic machine tools.

Business machine components being produced from metal powders usually have highly complex shapes. Their designs may be characterized by such features as thin, large flanges on shaped bushings, with meshing teeth on their periphery, sharp transitions between massive elements, for instance, transitions between a thin disk and a boss or a gear rim, thin stiffening ribs, and narrow recesses, which present considerable difficulties not only in the manufacture of dies, but also in the actual pressing and sintering operations. To prevent deformation of such parts during sintering, special clamping devices must be employed.

Use of high compaction pressures has a marked deleterious effect upon the operating life of the expensive working elements of die sets. Here adding a bulk sizing operation in the manufacture of thin and dense parts may well prove to be advantageous from an economic point of view. However, experience with the use of sintered components in cash registers and adding and invoicing machines has demonstrated that, because of their inherent bulk porosity, they are inferior in corrosion resistance to cast components, unless recourse is had to alloying or some form of anticorrosion treatment. Corrosion, of course, decreases their useful life and necessitates more frequent maintenance work.

Yet comparatively little attention appears to have been given to this topic in the literature, so that a serious gap exists in our knowledge of the behavior of sintered constructional materials. The task of filling this gap is usually left to the engineers in the factory responsible for the introduction and satisfactory operation of constructional components—a situation which is undoubtedly an obstacle to more extensive application of sintered constructional parts in industry. In the work described below, two different approaches were adopted to the problem of increasing the corrosion resistance of sintered parts, namely, additional heat treatment of finished articles in steam and combination of sintering and chromizing (sintering in a low-cost chromium-containing packing material).

Heat Treatment in Steam. Steam heat treatment experiments were carried out on the following parts: the body of a ball stop of an adding machine, made from iron powder with 5% of copper (part No. 1019); an antifriction bushing made from iron powder with 1.2% of graphite (part K1-1403); a gear of a cash register (part P17-258); the support of the printing mechanism of an invoicing machine (part VM-852); the catch of a removable cylindrical lock, made from pure iron powder (part 1P8.360.132) (Fig. 1).


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Fig. 1. Drawings of some components of adding and business machines (full-scale): a) body of ball stop; b) catch; c) support of printing mechanism; d) antifriction bushing; e) gear with thin disk and protruding boss.

The parts were pressed in a 100-ton P474 press and sintered, for 2 h at 1150°C, in a TsÉP-214 muffle furnace provided with a hydrogen atmosphere. After technical inspection, they were subjected to steam treatment, which was performed in a Ts-35 furnace at a constant temperature of 500°C. Steam from the factory main was superheated to 250°C at a pressure of 0.5 atm and supplied to the furnace at a constant rate of feed. The design of the Ts-35 furnace is illustrated in Figs. 2 and 3. The steam superheater, which has a diameter of 500 mm and a height of 730 mm, consists of 13 coils round a crucible and is made from a heat resisting tube of 18-mm diameter and 3-mm wall thickness. The installation is switched on from a control desk. In our experiments, the superheated steam temperature was measured with an MM-06 millivoltmeter to MRTU-9772-65 technical specification. The temperature sensing element employed was a